

ON TWO NEW SPECIES OF *PHILODINA*.

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## PLATE 27.

ALTHOUGH a few of the species belonging to the genus *Philodina* can be readily identified by means of their pronounced and obvious peculiarities of structure, the majority, forming what may be called the central group, agree somewhat closely in all the more important or salient details, and can only be recognised with any approach to certainty by attention to points which, to the uninitiated, may seem to be exceedingly trivial. In the closely related genus *Callidina*, with its much greater array of species, the difficulty of identification is greatly lessened by its wide range of variation, and one is able to rely with confidence upon characters afforded by the proportions of the corona, by the form of the upper lip, by the number of teeth, by the treatment of the food, and by the structure of the various parts of the foot.

In the central group of the genus *Philodina* there is comparatively little variation in any of these details, with the exception of those processes upon the penultimate foot segment known as the spurs. In the form, length, distance apart, and direction of these processes there is considerable, although perhaps not very conspicuous, variation. So far as I have been able to judge, the individual variation, or that which obtains among the individuals of one species, is extremely slight, whilst the specific variation (*i.e.* as between the different species) is sufficiently characteristic and remarkably constant. I have come therefore to rely mainly upon

this character in the determination of specimens otherwise of doubtful identity. But while the spurs are thus useful for systematic purposes, the foot as a whole is itself interesting as the highest development found among Bdelloid Rotifera of that portion of the body. Those who are interested in these animals will remember that, by some unexplained error, Hudson and Gosse laid down as one of the characteristics of the order Bdelloida that the toes were three in number. It is now well known that in the genus *Philodina* the toes seem to be invariably four, whilst in the genus *Callidina*, as at present constituted, there are species with four toes, others with three, and some without any.

As I am not aware of the existence of any figures which clearly show the plan on which the four toes are arranged in the typical *Philodina* foot, I have introduced into the accompanying plate a slightly diagrammatic outline of the hinder portion of the foot of *Philodina roseola*, drawn from an individual under compression sufficient to force out the foot to the fullest extent.

It is clear from their descriptions that Hudson and Gosse regarded the foot of a *Philodina* as including all the segments behind that sudden diminution of the width of the body so conspicuous in *Philodina citrina* or *P. megalotrocha*. Inasmuch, however, as this diminution, apparently marking off the foot from the central body or trunk, is scarcely noticeable in some species, and in others does not occur at the corresponding segment of the body, this view of the foot limits does not commend itself as reliable or advantageous for comparison. Later writers have therefore unanimously agreed to regard the foot, throughout all the genera of the Bdelloida, as comprising only those segments which are subsequent to the anus. In the genus *Philodina* there are usually four of these segments, but in *P. roseola* and *P. erythropthalma* there are five, and in *P. commensalis*, I believe, six. In the two former species the upper part of the foot consists of three segments of nearly equal length. In those other species which have a foot of four segments in all, the first segment is usually much longer than the second. It would seem, therefore, that the extra segment has been evolved by the division of this usually long first segment into two shorter segments. In either case the penultimate segment bears the spurs—two dorsal

processes whose function, as I believe, is simply to act as mere supports to the foot when the animal is feeding, and as buffers to lessen the shock of the recoil when the animal, in alarm, contracts itself violently upon its affixed foot-base.

It has been stated that the spurs are perforate, but I have not in any species been able to detect any trace of perforation, or of capability, by the exudation of mucus or otherwise, to attach the spurs, or to lay hold by them in any way of the surface they may touch. Their bases are undoubtedly hollow, but their apices appear to me to be solid and imperforate. They are usually stiff, but may occasionally be observed to bend when under temporary strain.

When the foot is fully protruded, as in the specimen sketched, it is seen that the penultimate segment extends a little way below the bases of the spurs. A few species which usually feed while extended to their greatest length, habitually show this lower portion of the segment. In species which adopt a more or less squatting position when feeding, it is rarely exposed.

The terminal segment is furnished with two pairs of toes, the dorsal and the terminal. The dorsal toes are usually much smaller than the terminal, and are placed at some distance above them. When in their natural position they stand out from the foot surface nearly parallel to each other (not strongly divergent, as shown in sketch, and as caused by pressure of cover-glass). Although it is clear, when the foot is thus protruded straight out behind the body, that these two toes are on the dorsal side, this position is rarely seen when the animal is free, and does not occur in the ordinary course of locomotion, but only when it desires to creep backwards, as sometimes happens. In the act of creeping forwards, when the body has been extended to its utmost, and hold has been taken with the tip of the rostrum or anterior extremity, the foot is released and the body, partly contracting in telescopic fashion, partly arching like the caterpillar of a geometer moth, is drawn up towards the rostrum. At the moment when the foot has been brought forward as far as possible and seems to be on the point of being set down, the terminal segment, until now concealed, is shot forward below the animal, the terminal toes are applied and become affixed, and almost simultaneously, by the telescopic action of the foot parts,

the dorsal toes arrive and attach themselves behind the others, while the spurs take a position immediately at the rear of all the toes, which are at once invaginated, their tips remaining affixed. By the bending of the foot forwards underneath the body, the dorsally placed toes are brought into use as well as the terminal. The latter pair are stout, of moderate length, and of two joints, the distal being telescopically retractile within the proximal.

Each pair of toes is capable of independent motion, and must therefore be provided with distinct muscles and controlling nerves. All four toes are broadly truncate, and their tips are pierced with several pores, from which ducts pass upwards through the foot to the cells which form the foot-glands. These glands are each built up of a series of large nucleate cells extending from a little way above the spurs as far as or, in some cases, even beyond the anus. The mucus secreted by them passes down the ducts, and is exuded through the pores in the tips of the toes.

In the three-toed species of *Rotifer* and *Callidina* the central toe is dorsal, the external toes terminal; but there is practically no interval between their bases, and their movements are usually simultaneous.

The two new species whose descriptions are appended resemble each other in several particulars. Both are rather below the usual size of *Philodinae*, and both usually adopt a squatting position when feeding. In each case the eyes are frequently indefinable, and when visible are small and round. The spurs are so nearly alike that, while they absolutely distinguish these two species from all others described, they do not afford reliable distinction between the one species and the other. Fortunately, however, the two forms are readily recognised by the skin, which in *P. rugosa* is rough and more or less opaque, and in *P. nemoralis* is smooth and transparent.

#### PHILODINA NEMORALIS, n. sp.

*Sp. Ch.*—Rather small for the genus. Skin smooth. Dental formula, 2/2. Foot of four joints; spurs short, slender, acute, and separated by an interstice nearly as wide as their length.

Central portion of upper lip bounded by ridge-like folds of skin. Eyes small and round.

This form might easily be passed over as merely an immature or small variety of *P. citrina*, but it differs distinctly and sufficiently from that species in the above noted characters of the spurs and of the upper lip. It occurs usually in mosses growing on or near damp ground, but is also to be taken in *Sphagnum* and in mossy pools. The alimentary regions are sometimes colourless, more often yellowish-red, occasionally of a faint green tint. Although in most cases the length does not exceed 285  $\mu$  when extended, yet in some localities it seems to attain decidedly larger proportions.

Its general form is scarcely so robust as usual among those *Philodinae* which have a four-jointed foot. The corona is moderately wide, 45 to 55  $\mu$ , the pedicels separated by a sulcus of average width and depth. The upper lip has its central portion bounded at each side by a ridge-like fold of skin which invests the bases of the pedicels on the inner and dorsal sides. The collar has a breadth of 38 to 44  $\mu$ , and is always distinctly greater than the neck, 29 to 32  $\mu$ . The dorsal antenna is of fair length, and each trochal disk possesses a seta or pencil of setae arising from a slight central prominence.

The mastax and internal organs generally, so far as made out, present no peculiarities. The rami are about 16  $\mu$  long, and have each two distinct transverse bars, and occasionally a fainter bar indicated more or less plainly. The lumen of the stomach is slender and lined with cilia. In dorsal view the eyes are small and round and of the usual red colour. When the animal is feeding, the rather short and slender foot is generally concealed beneath the posterior segments of the trunk. The spurs are from 4 to 6  $\mu$  long, and the interstice between them is about 4  $\mu$  wide. They are usually held at a slightly divergent angle, and may occasionally be seen to be bent abruptly, as though not absolutely stiff. The four toes are in two pairs, the dorsal pair smaller than the terminal, as usual.

I found this interesting species first near the Cuckoo Pits in Epping Forest in 1893, and in later years in other localities in Essex and also near Folkestone. I have received it also from Forstmeister Bilfinger, of Stuttgart, from Mr. Lord of Rawtenstall, and from Mr. James Murray, who has sent it from

various Scottish localities, including Loch Vennachar and Ben Nevis.

In confinement it is unusually hardy, and will live for months in a fraction of a drop of water in a suitable cell. Like a few other Bdelloid species, it is, under such circumstances, subject at times to what must be looked upon as a pathological condition of the gastric glands. These organs usually include in their substance a small number of minute, clear spaces or vacuoles. In this abnormal or diseased condition one (or more) of the glands has some of the vacuoles so greatly enlarged that the whole gland is like one large, clear vesicle, and in some cases is swollen much beyond its customary size. Strange to say, this condition of the glands does not appear to seriously affect the health of the individuals attacked, or, at all events, to lead to their rapid decease. When the disease shows itself, it generally affects most of the individuals in the cell.

Where *P. nemoralis* occurs, it is usually in fair numbers, and it is certainly a widely distributed species, not uncommon in its own group of habitats, but easily overlooked.

#### *PHILODINA RUGOSA*, n. sp.

*Sp. Ch.*—Small, rather stout. Skin of trunk shagreened; skin-folds prominent; ridges roughened, transversely wrinkled, or minutely sinuate. Rami  $18 \mu$  long; formula 3/3. Spurs short, moderately slender; bases separated by rather wide interstice. Eyes small and round.

I have much pleasure in giving to this species the name suggested for it by Forstmeister L. Bilfinger, who gave me in 1894 some particulars of the form now described as the type. Two years later I found a couple of specimens in moss collected in Spitsbergen by Dr. J. W. Gregory on the occasion of Sir Martin Conway's expedition to that island. With the exception that they were smaller, these specimens agreed well with the particulars of those found by my correspondent near Stuttgart.

The minutely sinuous and prominent ridges of the skin-folds of the trunk give this form a very distinctive appearance. The skin is somewhat opaque and of a greyish-brown colour. The body is seldom seen extended, as the animal is extremely

sluggish in its habits. When feeding, it invariably conceals its foot beneath the hinder part of the body—a habit which gives it an additional appearance of stoutness. The corona ( $45\ \mu$ ) is little wider than the collar ( $40\ \mu$ ). The sulcus between the pedicels is only moderately wide, and the central portion of the upper lip is slightly concave. In dorsal view the eyes are small and round. The rather short and stout foot has spurs  $6\ \mu$  long, scarcely so slender or so acute as those of *P. nemoralis*, and the interstice between them is nearly equal to their length. The Stuttgart examples measured  $270\ \mu$ ; those from Spitsbergen only about  $230\ \mu$ . My figure represents one of the latter.

I include in this species two fairly well-marked varieties. The first of these, *coriacea*, is a rather larger form, and differs from the type in the lesser prominence of the lateral series of skin-folds, the obliteration of the dorsal series, and the absence of the sinuous and roughened ridges so conspicuous in typical examples. The skin of the trunk is profusely shagreened, reddish-brown, and rather opaque. The spurs in this variety are about  $9\ \mu$  long, and the interstice between their bases is slightly convex, with a distinct central notch. A series of specimens were found in liverworts taken from a tree near Sandling Junction, Kent, in 1896.

The other variety—*callosa*—was really met with before the others, one or two specimens having been found in moss brought to me by my niece from Baden in 1893. These specimens, like others since examined, showed no trace of eyes, and were therefore judged to belong to the genus *Callidina*. I detected the eyes, however, in some specimens found at Slindon, Sussex, in 1895. In more recent years I have had this form from Edge Hill, Warwickshire, Norton's Heath, Essex, and from Hollingbourne, Kent, nearly always in liverworts. Mr. James Murray has found it not only in the same plants, but also in the open water of a Scottish loch. This variety would thus seem to be the most widely distributed in this country, but I have rarely met with more than one or two individuals at a time.

It is nearly intermediate between the typical *rugosa* and the variety *coriacea*. In general style it resembles the latter; but the skin-folds are faintly ridged and transversely wrinkled, and the skin less distinctly shagreened. The colour is pale yellowish-red or faintly greenish. In size it resembles the type form, and

probably frequently escapes detection for that reason, and because of its timid and sluggish nature. In some specimens the skin is slightly viscid.

## EXPLANATION OF PLATE 27.

- Fig. 1. *Philodina nemoralis*, n. sp., dorsal view, feeding. × 480.  
,, 1a. ,, ,, foot more extended. × 480.  
,, 2. *Philodina rugosa*, n. sp., dorsal view, feeding. × 480.  
,, 3. *P. rugosa*, n. sp., variety *coriacea*, dorsal view, feeding.  
× 480.  
,, 3a. ,, ,, ,, foot extended.  
,, 4. *P. roseola*, lower part of foot (under compression). × 800.